Department of Electrical and Computer Engineering
New Jersey Institute of Technology

ECE 425 Wireless Communication Systems (3 credits, 3 contact hours, elective course)

Instructor: Alexander Haimovich
Email: haimovic@njit.edu

Catalog Course Description:

This course is focused on the technical challenges and solutions to physical and link layer design of wireless communication systems. Course topics include characterization of the wireless channel, the cellular concept, digital modulation techniques, spread spectrum, multiple access techniques including CDMA and OFDMA, diversity techniques. Advanced techniques such as LTE, MIMO, 5G NR technologies are introduced. Matlab is used for examples and assignments.

Prerequisites: ECE 481 or ECE 421.

Textbooks: T. S. Rappaport, Wireless Communications: Principles and Practice (2nd Edition).
ISBN: 0130422320

Specific Course Learning Outcomes (CLOs):

The student who successfully completes Wireless Communications will:

1. Understand the basics of propagation of radio signals.
2. Gain an understanding of the design principles of cellular systems.
3. Understand how radio signals can be used to carry digital information in a spectrally efficient manner.
4. Gain knowledge of multiple access techniques based on frequency division, time division and code division.
5. Gain insights into how diversity afforded by radio propagation can be exploited to improve performance.
6. Gain knowledge of the basics of wireless standards such as LTE and 5G.

Relevant student outcomes (ABET criterion 3):

1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics (CLOs 1-6).
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (CLOs 1-6).
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies (CLOs 1-6).

Course policy:

- Midterm, 2 hours, 45%
- Final, 2 hours, 45%
- 1 page with equations allowed in each of the exams. Calculators also allowed. No other material allowed.
- Homework assignments 10%
- Class participation 5%

Matlab

Basic Matlab skills are required (may be acquired during the course)
Basic Matlab needed for homework assignments

Syllabus

Week	Topic
1	Module 1: Overview of wireless communication systems
2	Module 2: Pathloss models
3	Module 3: Multipath channel models
4	Module 4: Cellular concept
5	Module 5: Basics of digital communications
6	Module 6: Modulation methods
7	Module 6: Modulation methods (continued)
8	Module 7: Spread spectrum
9	Midterm exam
10	Module 8: Multiple access
11	Module 9: Diversity, equalization and coding
12	Module 10: OFDM and LTE
13	Module 11: MIMO
14	Module 12: 5G NR